**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**
**REGION III**
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# Total Maximum Daily Loads for the Primary Contact Use (Bacteriological) Impairment In the Pamunkey River Basin

*Signed*

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**Decision Rationale**

**Total Maximum Daily Loads for**
**The Primary Contact Use (Bacteriological) Impairment**
**In the Pamunkey River Basin**

## I. Introduction

The Clean Water Act (CWA) requires that a Total Maximum Daily Load (TMDL) be developed for those water bodies identified as impaired by a state where technology-based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety (MOS), that may be discharged to a water quality-limited water body.

This document will set forth the Environmental Protection Agency's (EPA) rationale for approving the TMDLs for the primary contact use (bacteriological) impairments within the Pamunkey River Basin. EPA's rationale is based on the determination that the TMDL meets the following eight regulatory conditions pursuant to 40 CFR §130.

1) The TMDLs are designed to implement applicable water quality standards.
2) The TMDLs include a total allowable load as well as individual waste load allocations (WLAs) and load allocations (LAs).
3) The TMDLs consider the impacts of background pollutant contributions.
4) The TMDLs consider critical environmental conditions.
5) The TMDLs consider seasonal environmental variations.
6) The TMDLs include a MOS.
7) There is reasonable assurance that the TMDLs can be met.
8) The TMDLs have been subject to public participation.

## II. Background

The Pamunkey River Basin stretches across several counties in Virginia including Orange, Albemarle, Louisa, Spotsylvania, Hanover and King William. The TMDLs address eleven impaired stream segments on eight streams. These waters were all listed on Virginia's 2004 Section 303(d) List for violating the Commonwealth's bacteriological criteria. This decision rationale will address the TMDLs for the impairment of the primary contact use. Table 1 identifies each impaired segment, the initial listing date, and the segment impairment delineation. Table 2 identifies the watershed acreage and the percent land use within each watershed.

Table 1 – Impaired Segments within Pamunkey River Basin

| Stream Name and Segment ID | Listing Date | Stream Delineation |
|---|---|---|
| South Anna River (VAN-F01R-01) | 2002 | Headwaters to confluence with Dove Fork (7 miles) |
| South Anna River (VAN-F02R-01) | 2004 | Confluence of Roundabout Creek to Confluence with Beaver Creek (6.3 miles) |
| South Anna River (VAP-F04R-01) | 2002 | Confluence with Taylors Creek to Ashland Municipal Sewage Treatment Plant (STP) (22 miles) |
| South Anna River (VAP-F04R-02) | 1998 | Ashland Municipal STP to Falling Creek (4.63 Miles0 |
| Taylors Cr. (VAN-F03R-01) | 2002 | Headwaters to mouth (16 miles) |
| Newfound River (VAP-F05R-01) | 2004 | Confluence with Needstan Creek to mouth (10 miles) |
| Northeast Cr. (VAP-F09R-01) | 2002 | From tributary upstream of Route 622 to confluence downstream of Route 622 (1 mile) |
| Totopotomoy Cr. (VAP-F13R-02) | 2002 | Confluence with Strawhorn Creek to mouth (9 miles) |
| Monquin/Webb Cr. (VAP-F13R-04) | 2002 | Headwaters of Webb Creek to river mile 2.0 (11 miles) |
| Black Cr. (VAP-F13-05) | 2002 | Southern Branch Clompton Swamp to its mouth (2 miles) |
| Pamunkey River (VAP-F13E-02) | 1998 | Route 654 to confluence of Macon Creek (1 mile) |

Table 2 – Land Use Area

| Stream Segment | Area | Forest (%) | Agriculture (%) | Residential (%) | Water/ Wetland (%) |
|---|---|---|---|---|---|
| South Anna River (VAN-F01R-01) | 6,010 | 48 | 45 | 4 | 3 |
| South Anna River (VAN-F02R-01) | 95,070 | 69 | 26 | 2 | 3 |
| South Anna River (VAP-F04R-01) | 262,860 | 68 | 28 | 2 | 2 |
| South Anna River (VAP-F04R-02) | 298,300 | 67 | 30 | 1 | 2 |
| Taylors Cr. (VAN-F03-01) | 25,530 | 71 | 27 | 1 | 1 |
| Newfound River (VAP-F05R-01) | 26,530 | 59 | 38 | 1 | 2 |
| Northeast Cr. (VAP-F09R-01) | 26,990 | 75 | 23 | 1 | 1 |
| Totopotomoy Cr. (VAP-F13R-02) | 20,050 | 53 | 33 | 12 | 2 |
| Monquin/Webb Cr. (VAP-F13R-04) | 15,710 | 68 | 28 | 1 | 3 |
| Black Cr. (VAP-F13-05) | 20,730 | 77 | 19 | 1 | 4 |
| Pamunkey River (VAP-F13E-02) | 872,620 | 65 | 29 | 2 | 4 |

Fecal coliform is a bacterium which can be found within the intestinal tract of all warm blooded animals. Therefore, fecal coliform can be found in the fecal wastes of all warm blooded animals. Fecal coliform in itself is not a pathogenic organism. However, fecal coliform indicates the presence of fecal wastes and the potential for the existence of other pathogenic bacteria. The higher concentrations of fecal coliform indicate the elevated likelihood of increased pathogenic organisms.

EPA encouraged the states to use *e-coli* and *enterococci* as the indicator species instead of fecal coliform. A better correlation was drawn between the concentrations of *e-coli* and *enterococci*, and the incidence of gastrointestinal illness. The Commonwealth adopted *e-coli* and *enterococci* criteria in January 2003. According to the new criteria, streams will be evaluated via the *e-coli* and *enterococci* criteria after 12 samples have been collected using these indicator species. The fecal coliform criteria will be used in the interim. Twelve *e-coli* samples

were collected from each of the impaired segments, and they are assessed according to the new criteria.

As Virginia designates all of its waters for primary contact, all waters were required to meet the bacteriological standard for primary contact. Virginia's standard applies for all flows, there are no high or low flow exemptions. The *e-coli* criteria requires a geometric mean concentration of 126 cfu/100 ml of water with no sample exceeding 235 cfu/100 ml of water. The new *e-coli* criterion requires the concentration of *e-coli* not exceed 235 cfu/100 ml of water.

Although the TMDL and criteria require the 235 cfu/100 ml of water concentration limit not be exceeded, waters are not placed on the Section 303(d) list if their violation rate does not exceed 10 percent. Therefore, waters within the Pamunkey River Basin may be deemed as attaining their primary contact use prior to the implementation of all of the TMDL reductions. It is necessary to keep this in mind because of the reductions required to attain the instantaneous criteria for *e-coli* in the model. Model results from most of the waters indicate that the fall of 1993 required the most stringent reductions in order to attain criterion.

The TMDL submitted by Virginia is designed to determine the acceptable load of *e-coli* which can be delivered to the impaired waters, as demonstrated by the Hydrologic Simulation Program Fortran (HSPF)[1], in order to ensure that the water quality standard is attained and maintained. HSPF was considered an appropriate model to analyze the impaired water because of its dynamic ability to simulate both watershed loading and receiving water quality over a wide range of conditions. The model was run to determine the fecal coliform loading to impaired segments within the Pamunkey River Basin. Table 3 identifies the model and calibration period used for each TMDL. The modeling determined the fecal coliform loading since most of the loading information and sampling results were based on fecal coliform. The in-stream fecal coliform concentrations were then converted to e-coli using a conversion factor established by the Commonwealth.

Table 3 – TMDL Modeling Information

| Stream | Model | Gage | Calibration Period | Primary Weather Station |
|---|---|---|---|---|
| South Anna River | HSPF | USGS #01672500 | 1992 through 1997 | Piedmont Research Station |
| Totopotomy Cr | HSPF | USGS #01673550 | 1992 through 1997 | Richmond Airport |
| Northeast Cr | HSPF, Paired Watershed | USGS #01672500 | 1992 through 1997 | Piedmont Research Station |

[1]Bicknell, B.R., J.C. Imhoff, J.L. Little, and R.C. Johanson. 1993. Hydrologic Simulation Program-FORTRAN (HSPF): User's Manual for release 10.0. EPA 600/3-84-066. U.S. Environmental Protection Agency, Environmental Research Laboratory, Athens, GA.

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|---|---|---|---|---|
| Monquin/Webb Cr | HSPF, Paired Watershed | USGS #01673550 | 1992 through 1997 | Richmond Airport |
| Black Cr | HSPF, Paired Watershed | USGS #01673550 | 1992 through 1997 | Richmond Airport |
| Pamunkey River | HSPF, Paired Watershed and WASP | USGS #01673550 | 1992 through 1997 | Richmond Airport |

The TMDL analysis allocates the application/deposition of fecal coliform to land based and instream sources. For land based sources, the HSPF model accounts for the buildup and washoff of pollutants from these areas. Buildup (accumulation) refers to the complex spectrum of dry-weather processes that deposit or remove (die-off) pollutants between storms.[2] Washoff is the removal of fecal coliform which occurs as a result of runoff associated with storm events. These two processes allow the HSPF model to determine the amount of fecal coliform from land based sources which is reaching the stream. Point sources and wastes deposited directly to the stream were treated as direct deposits. Wastes which are deposited directly to the stream do not need a transport mechanism.

Local rainfall and temperature data were needed to develop the model. Weather data provides the rainfall data which drives the TMDL model. Weather data was collected from several weather stations including Richmond Airport and the Piedmont Research Station. A hydrologic calibration was conducted for the South Anna River (USGS #01672500) and Totopotomy Creek (USGS #01673550). These models were used for the streams that did not house a gage on them as well. The TMDL was modeled using fecal coliform loading rates as was done in previous TMDL efforts. The fecal coliform concentrations were then converted e-*coli* concentrations using a translator equation developed by VADEQ. Significant reductions in the modeled load were required in order for impaired segments to attain the *e-coli* criteria in the model. More stringent reductions were required to meet the instantaneous standard than the geometric mean.

Table 4a - Provides the Annual Load for Each TMDL

| Stream Name | WLA (cfu/yr) | LA (cfu/yr) | MOS | TMDL (cfu/yr) |
|---|---|---|---|---|
| South Anna River (VAN-F01R-01) | 1.64E+12 | 3.67E+12 | N/A | 5.31E+12 |
| South Anna River (VAN-F02R-01) | 1.48E+12 | 7.96E+12 | N/A | 9.44E+12 |
| South Anna River (VAP-F04R-01) | 1.02E+12 | 2.98E+13 | N/A | 3.08E+13 |
| South Anna River (VAP-F04R-02) | 3.48E+12 | 3.13E+13 | N/A | 3.48E+13 |
| Taylors Cr. (VAN-F03-01) | 1.89E+09 | 1.89E+11 | N/A | 1.91E+11 |
| Newfound River (VAP-F05R-01) | 2.89E+10 | 2.89E+12 | N/A | 2.92E+12 |
| Northeast Cr. (VAP-F09R-01) | 2.30E+10 | 2.30E+12 | N/A | 2.32E+12 |
| Totopotomoy Cr. (VAP-F13R-02) | 1.62E+10 | 1.62E+12 | N/A | 1.64E+12 |
| Monquin/Webb Cr. (VAP-F13R-04) | 8.71E+10 | 1.81E+11 | N/A | 2.68E+11 |
| Black Cr. (VAP-F13-05) | 1.26E+10 | 1.26E+12 | N/A | 1.27E+12 |
| Pamunkey River (VAP-F13E-02) | 7.40E+12 | 7.40E+14 | N/A | 7.47E+14 |

[2]CH2MHILL, 2000. Fecal Coliform TMDL Development for Cedar, Hall, Byers, and Hutton Creeks Virginia,

Table 4b – Provides the Daily Load for Each TMDL

| Stream Name | WLA (cfu/day) | LA (cfu/day) | MOS | TMDL (cfu/day) |
|---|---|---|---|---|
| South Anna River (VAN-F01R-01) | 4.49E+09 | 1.01E+10 | N/A | 1.45E+10 |
| South Anna River (VAN-F02R-01) | 4.05E+09 | 2.18E+10 | N/A | 2.59E+10 |
| South Anna River (VAP-F04R-01) | 2.79E+09 | 8.16E+10 | N/A | 8.44E+10 |
| South Anna River (VAP-F04R-02) | 9.53E+09 | 8.58E+10 | N/A | 9.53E+10 |
| Taylors Cr. (VAN-F03-01) | 5.18E+06 | 5.18E+08 | N/A | 5.23E+08 |
| Newfound River (VAP-F05R-01) | 7.92E+07 | 7.92E+09 | N/A | 8.00E+09 |
| Northeast Cr. (VAP-F09R-01) | 6.30E+07 | 6.30E+09 | N/A | 6.36E+09 |
| Totopotomoy Cr. (VAP-F13R-02) | 4.44E+07 | 4.44E+09 | N/A | 4.49E+09 |
| Monquin/Webb Cr. (VAP-F13R-04) | 2.39E+08 | 4.96E+08 | N/A | 7.34E+08 |
| Black Cr. (VAP-F13-05) | 3.45E+07 | 3.45E+09 | N/A | 3.48E+09 |
| Pamunkey River (VAP-F13E-02) | 2.03E+10 | 2.03E+12 | N/A | 2.05E+12 |

Many of Virginia's TMDLs, including the TMDLs for the Pamunkey River Basin, have called for some reduction in the amount of wildlife contributions to the impacted streams. EPA believes that a significant reduction in wildlife is not practical and will not be necessary due to the implementation plan discussed below. A phased implementation plan will be developed for all streams in which the TMDL calls for reductions in wildlife. In Phase 1 of the Commonwealth will begin implementing the reductions (other than wildlife) called for in the TMDL. In Phase 2, which can occur concurrently to Phase 1, the Commonwealth will consider addressing its standards to accommodate this natural loading condition. After the completion of Phase 1 the Commonwealth will monitor the stream to determine if the wildlife reductions are actually necessary, as the violation level associated with the wildlife loading may be smaller than the percent error of the model. In Phase 3, the Commonwealth will investigate the sampling data to determine if further load reductions are needed in order for these waters to attain standards. If the load reductions and/or the new application of standards allow the stream to attain standards, then no additional work is warranted. However, if standards are still not being attained after the implementation of Phases 1 and 2, further work and reductions will be warranted

The United States Fish and Wildlife Service has been provided with copy of these TMDLs.

## III. Discussion of Regulatory Conditions

EPA finds that Virginia has provided sufficient information to meet all of the eight basic requirements for establishing a primary contact (bacteriological) impairment TMDLs for the Pamunkey River Basin. EPA is therefore approving these TMDLs. EPA's approval is outlined according to the regulatory requirements listed below.

*1) The TMDLs are designed to meet the applicable water quality standards.*

Virginia has indicated that excessive levels of fecal coliform due to nonpoint sources

(both wet weather and directly deposited nonpoint sources) have caused violations of the water quality criteria and designated uses in the Pamunkey River Basin. The Commonwealth has changed its bacteriological criteria as indicated above. The new *e-coli* criteria requires a geometric mean of 126 cfu/100ml of water with no sample exceeding 235 cfu/100 ml of water.

The HSPF model was used to determine the fecal coliform deposition rates to the land as well as loadings to the stream from direct deposit sources. Once the existing load was determined, allocations were assigned to each source category to develop a loading pattern that would allow each of the impaired segments within the basin to support the *e-coli* water quality criterion and primary contact use. The following discussion is intended to describe how controls on the loading of e-coli will ensure that the criterion is attained.

The TMDL modelers determined the fecal coliform production rates within the watershed. Data used in the model was obtained from a wide array of sources, including farm practices in the area, the amount and concentration of farm animals, animal access to the stream, wildlife in the watershed, wildlife fecal production rates, landuses, weather, stream geometry, etc.. The model combined all of the data to determine the hydrology and water quality of the stream. The lands within the watersheds were categorized into specific landuses. The landuses had specific loading rates and characteristics that were defined by the modelers. Therefore, the loading rates are different in lands defined as forested versus pasture. Pasture lands support cattle and are influenced differently by stormwater runoff.

The TMDL models were run using weather data collected from several area weather stations. This data was used to determine the precipitation rates in the watersheds which transport the on land pollutants to the streams through overland and groundwater flows. Waste that was deposited to the land or stored was subjected to a die-off rate. The longer fecal coliform stayed on the ground the greater the die-off was. Materials that were washed off the surface shortly after deposition were subjected to less die-off. As stated above the models were calibrated to observed flow data from the South Anna River or Totopotomy Creek. The water quality models were calibrated to observed data from each of the impaired waters. The models were adjusted so that the simulated results matched the observed results and then the parameters were all held constant and the model was validated against a different set of data. The allocations were developed to the validated model and reductions were made until the simulated bacteria concentrations were below the applicable criteria.

*2) The TMDLs include a total allowable load as well as individual waste load allocations and load allocations.*

Total Allowable Loads

Virginia indicates that the total allowable loading is the sum of the loads allocated to land based precipitation driven nonpoint source areas (forest and agricultural land segments) and point sources. Activities that increase the levels of bacteria to the land surface or their availability to runoff are considered flux sources. The values for total loading can be found in Table 4 of this document. The total allowable loads were calculated on an annual and daily basis.

Waste Load Allocations

EPA regulations require that an approvable TMDL include individual WLAs for each point source. According to 40 CFR § 122.44(d)(1)(vii)(B), "Effluent limits developed to protect a narrative water quality criterion, a numeric water quality criterion, or both, are consistent with assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA pursuant to 40 CFR § 130.7." Furthermore, EPA has authority to object to the issuance of any National Pollutant Discharge Elimination System (NPDES) permit that is inconsistent with the WLAs established for that point source.

Virginia has stated that there are several regulated point sources discharging within the Pamunkey River Basin. A WLA has been provided for each of these facilities based on their flow and the permissible concentration of *e-coli* in their effluent, 126 cfu/100 ml. Table 5 documents the WLA for each of these point sources.

Table 5 – WLA for Bacteria for Beaver Creek

| Stream Name | Permit Number | Facility | E-Coli (cfu/yr) |
|---|---|---|---|
| South Anna River | VA0021105 | Gordonville Sewage Treatment Plant (STP) | 1.64E+12 |
| South Anna River | VA0088706 | Virginia Oil-Zion Crossroads | 6.87E+10 |
| South Anna River | VA0090743 | Zion Crossroads Wastewater Treatment Plant (WWTP) | 1.22E+12 |
| South Anna River | VA0076678 | Shenandoah Crossing | 1.74E+11 |
| South Anna River | VAG116048 | Ready Mixed Concrete | 1.69E+09 |
| South Anna River | VAG251002 | Klochner Pentaplast | 1.69E+09 |
| South Anna River | VAG406073 | Residence | 1.69E+09 |
| South Anna River | VA0088421 | Twin Oaks Community (STP) | 1.74E+10 |
| South Anna River | VA0067954 | Louisa Regional Sewage | 6.96E+11 |
| South Anna River | VA0090409 | Gum Spring Sewage | 2.79E+10 |
| South Anna River | VA0090140 | Six O Five Village M H P STP | 6.96E+10 |
| South Anna River | VA0067105 | Missionary Learning Center | 4.35E+10 |
| South Anna River | VAG404000 | Residence | 7.88E+08 |
| South Anna River | VAG404200 | Elk Lodge 45 | 9.00E+08 |
| South Anna River | VAG404205 | Residence | 1.69E+09 |
| South Anna River | VAG404210 | Residence | 7.88E+08 |
| South Anna River | VAG404217 | Residence | 1.01E+09 |
| South Anna River | VA0022641 | Patrick Henry High School | 6.96E+10 |
| South Anna River | VA0060232 | Country Club Hills Lagoon | 1.04E+11 |
| South Anna River | VAG404222 | Residence | 7.88E+08 |
| South Anna River | VAG404066 | Lees Mobil Service | 1.69E+09 |

| | | | |
|---|---|---|---|
| South Anna River | VA0024899 | Ashland WWTP | 3.48E+12 |
| Monquin/Webb Cr | VA0088102 | King William STP | 8.71E+10 |

Load Allocations

According to Federal regulations at 40 CFR § 130.2(g), LAs are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading. Wherever possible, natural and nonpoint source loads should be distinguished.

In order to accurately simulate landscape processes and nonpoint source loadings, VADEQ used the HSPF model to represent the impaired watersheds. The HSPF model is a comprehensive modeling system for the simulation of watershed hydrology, point and nonpoint source loadings, and receiving water quality. HSPF uses precipitation data for continuous and storm event simulation to determine total loading to the impaired segments from the various land uses within the watershed. Table 3 lists the LAs for the impaired segments. The reductions needed to insure that the instantaneous criteria are attained at all times are extremely stringent. If the 10 percent violation rate required for a water to be placed on the Section 303(d) list was used as an endpoint, the reductions would not be as stringent.

Table 3a - LAs for Bacteria (fecal coliform) S. Anna River

| Source Category | S. Anna River (F01R-01) | S. Anna River (F02R-01) | S. Anna River (F04R-01) |
|---|---|---|---|
| Straight Pipes | 0.00 | 0.00 | 0.00 |
| Livestock Direct Deposit | 6.52E+10 | 0.00 | 1.20E+12 |
| Wildlife Direct Deposit | 5.37E+11 | 6.15E+12 | 1.02E+14 |
| Residential | 0.00 | 0.00 | 0.00 |
| Cropland | 3.27E+10 | 1.18E+12 | 5.65E+13 |
| Pasture | 2.15E+14 | 3.91E+14 | 3.08E+15 |
| Forest | 2.52E+13 | 4.09E+14 | 8.05E+14 |

Table 3b- LAs for Bacteria (fecal coliform) for S.Anna and Newfound Rivers and Taylors Creek

| Source Category | S. Anna River (F04R-02) | Taylors Creek (F03R-01) | Newfound River (F05R-01) |
|---|---|---|---|
| Straight Pipes | 0.00 | 0.00 | 0.00 |
| Livestock Direct Deposit | 2.24E+11 | 2.16E+11 | 9.48E+10 |
| Wildlife Direct Deposit | 9.48E+11 | 9.72E+11 | 4.50E+12 |
| Residential | 0.00 | 0.00 | 0.00 |
| Cropland | 1.51E+12 | 4.68E+10 | 4.10E+12 |
| Pasture | 2.83E+14 | 0.00 | 1.12E+15 |
| Forest | 5.27E+13 | 1.44E+14 | 1.76E+14 |

Table 3c – LAs for Bacteria (fecal coliform) for Northeast, Totopotomoy and Webb Creeks

| Source Category | Northeast Creek (F09R-01) | Totopotomoy Creek (F13R-02) | Monquin/Webb Creek (F13R-04) |
|---|---|---|---|
| Straight Pipes | 0.00 | 0.00 | 0.00 |
| Livestock Direct Deposit | 2.50E+11 | 2.99E+11 | 2.97E+10 |
| Wildlife Direct Deposit | 1.76E+12 | 2.08E+12 | 2.90E+11 |
| Residential | 0.00 | 0.00 | 0.00 |
| Cropland | 3.72E+11 | 3.13E+11 | 2.30E+11 |
| Pasture | 2.47E+14 | 3.20E+14 | 2.83E+13 |
| Forest | 1.38E+14 | 1.34E+14 | 1.44E+14 |

Table 3d – LAs for Bacteria (fecal coliform) for Black Creek and Pamunkey River

| Source Category | Black Creek (F13R-05) | Pamunkey River (F13E-02) |
|---|---|---|
| Straight Pipes | 0.00 | 0.00 |
| Livestock Direct Deposit | 2.92E+11 | 1.94E+12 |
| Wildlife Direct Deposit | 6.21E+12 | 1.82E+13 |
| Residential | 0.00 | 0.00 |
| Cropland | 1.49E+12 | 5.81E+12 |
| Pasture | 2.89E+14 | 2.01E+15 |

| | | |
|---|---|---|
| Forest | 2.05E+14 | 4.73E+14 |

*3) The TMDLs consider the impacts of background pollution.*

The TMDLs consider the impact of background pollutants by considering the bacteria load from background sources such as wildlife.

*4) The TMDLs consider critical environmental conditions.*

According to EPA's regulation 40 CFR § 130.7 (c)(1), TMDLs are required to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of Pamunkey River Basin is protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards[3]. Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable "worst-case" scenario condition. For example, stream analysis often uses a low-flow (7Q10) design condition because the ability of the waterbody to assimilate pollutants without exhibiting adverse impacts is at a minimum.

The HSPF model was run over a multi-year period to insure that it accounted for a wide range of climatic conditions. The allocations developed in the TMDL will therefore insure that the criterion is attained over a wide range of environmental conditions including wet and dry weather conditions.

*5) The TMDLs consider seasonal environmental variations.*

Seasonal variations involve changes in stream flow and loadings as a result of hydrologic and climatological patterns. In the continental United States, seasonally high flows normally occur in early spring from snow melt and spring rain, while seasonally low flows typically occur during the warmer summer and early fall drought periods. Bacteria loadings also change during the year based on crop cycles, waste application rates, and cattle access patterns. Consistent with our discussion regarding critical conditions, the HSPF models and TMDLs analyses

[3]EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

effectively considered seasonal environmental variations through the use of observed weather data over an extended period of time and by modifying waste application rates and livestock practices.

*6) The TMDLs include a margin of safety.*

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. The MOS may be implicit, built into the modeling process by using conservative modeling assumptions, or explicit, taken as a percentage of the WLA, LA, or TMDL. Virginia included an implicit MOS in the TMDL through the use of conservative modeling assumptions in the determination of bacteria loadings and production.

*7) There is a reasonable assurance that the TMDLs can be met.*

EPA requires that there be a reasonable assurance that the TMDLs can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR 122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs such as Section 319 of the CWA, commonly referred to as the Nonpoint Source Program.

*8 ) The TMDLs have been subject to public participation.*

Three public meetings were held to discuss and disseminate the Pamunkey River Basin TMDLs to the public. The first public meetings were held at the Louisa County Government Center and the King William High School on April 13 and 20, 2005. The second public meetings were held at the Louisa Government Center and Eastern Hanover Volunteer Company on December 7 and 8, 2005. The third public meetings were held at the same location as the second meetings on March 22 and 26, 2006. The meetings and TMDLs were noticed in the Virginia Register for a 30-day comment period. Two sets of written comments were received during the 30-day comment period.